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THE EXTENT OF THE APPLICATION OF THE CONSTRUCTIVIST PERSPECTIVE IN THE TEACHING AND LEARNING OF BIOLOGY AT 'O' LEVEL IN ZIMBABWE.

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Abstract

This article examines the extent to which the Biology 'O' level teachers are applying the constructivist perspective in the teaching and learning of Biology at 'O' level in Harare, in former group A government secondary schools in the low density suburbs. The population study consisted of three secondary schools in Zimbabwe. The data were collected from 'O' level Biology teachers, Science Head of Departments, lesson observations and from relevant documents in the schools. Interviews, questionnaires, document analysis and lesson observations were used to collect the data. The extent to which the constructivist perspective is being applied was determined by examining the teachers' knowledge on the constructivist perspective; analyzing documents such as the lesson plan books and the application of the constructivist perspective during the observed lessons. Most teachers who participated in this study showed adequate knowledge about the constructivist perspective in the teaching and learning of Biology at 'O' level. The lessons observed showed the lack of application of the constructivist perspective in the teaching and learning of Biology at 'O' level. Document analysis showed that most teachers were stating methods related to the constructivist perspective in the teaching and learning of Biology but they did not apply these in the actual teaching and learning of Biology as revealed by the lesson observations.

Introduction

The performance of students in Biology at O level in most secondary schools in Zimbabwe is rather poor according to the Zimbabwe school Examination council (ZIMSEC) reports for 2000, 2001 and 2002. Many factors have been attributed the poor performance of the students but little research has been done in Zimbabwe to link the methods of instruction used to the poor performance. Examination reports from ZIMSEC indicate that 'O' level Biology candidates seem to continue to lack an understanding of Biological concepts as well

as problem solving skills. The lack of these skills has contributed to the poor performance of these candidates in the 'O' level Biology final examination that has raised concern

Biology is a very important subject, which links student's life on a daily basis, but currently there is a high failure rate according to the ministry's 'O' level national result analysis. According to Mutasa and Wills (1994) "Science is not a process of thought which has revealed this information and which uses it in dealing with new mysteries... it demands powers of observation, criticism and careful planning... it also requires an imaginative vision that we often tend to associate only with the art."

Science instruction must promote students' observation, critical thinking, criticism, imagination and careful planning. The constructive perspective seems to be the best methodology to promote this in students. Children learn more and enjoy learning when they are actively involved, rather than being passive learners.

Purpose of the study

The purpose of this study was to evaluate the application of the constructivist approach in the teaching and learning of Biology at 'O' level and to analyze the teachers' perceptions on its use. The constructive perspective is one of the teaching approaches that prepare students for life in terms of dealing with day to day life problems because it encourages critical thinking (Helen, 2000). If this approach was to be adopted by all teachers in Zimbabwe, it would make a valuable contribution towards the improvement of the performance of students at 'O' level especially in Biology. It is hoped that the findings of the study will make suggestions that may improve the standard of teaching and learning of Biology at 'O' level in Zimbabwe.

Literature Review

Constructivism is an approach to teaching and learning based on the premise that cognition (learning) is the result of "mental construction." In other words, students learn by fitting new information together with what they already know. Constructivists believe that learning is affected by the context in which an idea is taught as well as by students' beliefs and attitudes. Constructivism is a view of learning based on the belief that knowledge can't simply be given by the teacher to students. Rather, learners through an active, mental process of development construct

knowledge; learners are the builders and creators of meaning and knowledge. Constructivism draws on the developmental work of Piaget (1977) and Kelly (1991).

Twomey Fosnot (1989) defines constructivism by reference to four principles:

- a) learning, in an important way, depends on what we already know;
- b) new ideas occur as we adapt and change our old ideas;
- c) learning involves inventing ideas rather than mechanically accumulating facts;
- d) meaningful learning occurs through rethinking old ideas and coming to new conclusions about new ideas which conflict with our old ideas.

A productive constructivist classroom consists of learner-centered and active instruction. In such a classroom, the teacher provides students with experiences that allow them to hypothesize, predict, manipulate objects, pose questions, research, investigate, imagine, and invent (Piaget, 1977). The teacher's role is to facilitate this process. Piaget (1977) asserts that learning occurs by an active construction of meaning, rather than by passive percipience. He explains that when learners encounter an experience or a situation that conflicts with our current way of thinking, a state of disequilibrium or imbalance is created. Learners must then alter their thinking to restore equilibrium or balance. To do this, learners make sense of the new information by associating it with what they already know, that is, by attempting to assimilate it into their existing knowledge.

Similar to this is Kelly's theory of personal constructs (Kelly, 1991). Kelly proposes that learners look at the world through mental constructs or patterns they create. Learners develop ways of construing or understanding the world based on learners' experiences. When they encounter a new experience, learners attempt to fit these patterns over the new experience. Constructivist beliefs have recently been applied to teaching and learning in the classroom.

To the researcher, "Constructivism" is an approach to education that views the teacher or trainer as more of a facilitator of learning than an instructor of pre-determined skills and facts. Students are strongly encouraged to take more control of their learning experience than they would in conventional classrooms. They are also encouraged to work in teams, to confront problems that do not necessarily have one answer, and to work on long-range projects that encompass several traditional disciplines.

Constructivism is basically a theory based on observation and scientific study about how people learn. People construct their own understanding and knowledge of the world, through experiencing things and reflecting on those experiences. When learners encounter something new, they have to reconcile it with their previous ideas and experiences, maybe changing what they believe, or maybe discarding the new information as irrelevant (Twomey Fosnot, 1989). In any case, learners are active creators of their own knowledge. To do this, learners must ask questions, explore, and assess what they know.

In the classroom, the constructivist view of learning can point towards a number of different teaching practices. In the most general sense, it usually means encouraging students to use active techniques (experiments, real-world problem solving) to create more knowledge and then to reflect on and talk about what they are doing and how their understanding is changing. The teacher must understand the students' pre-existing conceptions, and guides the activity to address them and then build on them. Constructivist teachers encourage students to constantly assess how the activity is helping them gain understanding. By questioning themselves and their strategies, students in the constructivist classroom ideally become "expert learners." This gives them ever-broadening tools to keep learning. With a well-planned classroom environment, the students learn how to learn (Twomey Fosnot, 1989). When learners continuously reflect on their experiences, students find their ideas gaining in complexity and power, and they develop increasingly strong abilities to integrate new information. One of the teacher's main roles becomes to encourage this learning and reflection processes. For example: Groups of students in a science class are discussing a problem in Biology. Though the teacher knows the "answer" to the problem, the teacher focuses on helping students restate their questions in useful ways. The teacher prompts each student to reflect on and examine his or her current knowledge. When one of the students comes up with the relevant concept, the teacher seizes upon it, and indicates to the group that this might be a fruitful avenue for them to explore. They design and perform relevant experiments. Afterward, the students and teacher talk about what they have learned, and how their observations and experiments helped (or did not help) them to better understand the concept. Contrary to criticisms by some (conservative/traditional) educators, constructivism does not dismiss the active role of the teacher or the value of expert knowledge.

Constructivism modifies that role, so that teachers help students to

construct knowledge rather than to reproduce a series of facts. The constructivist teacher provides tools such as problem-solving and inquiry-based learning activities with which students formulate and test their ideas, draw conclusions and inferences, and pool and convey their knowledge in a collaborative learning environment Twomey Fosnot (1989). Constructivism transforms the student from a passive recipient of information to an active participant in the learning process. Always guided by the teacher, students construct their knowledge actively rather than just mechanically ingesting knowledge from the teacher or the textbook. Constructivism is also often misconstrued as a learning theory that compels students to "reinvent the wheel." In fact, constructivism taps into and triggers the student's innate curiosity about the world and how things work. Students do not reinvent the wheel but, rather, attempt to understand how it turns, how it functions. They become engaged by applying their existing knowledge and real-world experience, learning to hypothesize, testing their theories, and ultimately drawing conclusions from their findings.

Methodology

This study was to evaluate the extent of the application of the Constructivist Perspective in the teaching and learning of Biology at "O" Level is the result of a case study conducted in three Harare Secondary Schools in the Northern suburbs.

A questionnaire for biology teachers to assess the teachers' knowledge about the teaching methods and the teaching aids was used. Another questionnaire was used to assess the Science Head of Department's knowledge about the importance of the teaching methods and how she or he monitors the teaching and learning of Biology at 'O' level especially the teaching methods. Lesson observations were also done in order to evaluate the application of the constructivist approach to the teaching and learning of Biology at 'O' level including interviews with the 'O' level Biology teachers.

Results

Table 1: Teachers' knowledge of the concept constructivist perspective in the teaching and learning of Biology at 'O' level

Question on	Acceptable answer		Non acceptable answer	
	Number	%	Number	%
Knowledge about the concept constructivist perspective in the teaching and learning of Biology at 'O' level	5	83.3	1	16.6
Knowledge about the impact of the constructivist perspective on assimilation of content and development of skills and attitudes in students	2	33,3	4	66.6

Table 2: Teaching methods used during the lessons observed and those stated in the plan books.

Teaching method	Number of teachers stating this method in the plan book	%	Number of teachers using this method in the observed lessons	%
Lecture	0	0	6	100
Group work	6	100	1	16,6
Class discussion	6	100	1	16,6
Problem solving	0	0	0	0
Demonstration	2	33,3	3	50
Discovery	0	0	1	16,6
Carrying out experiments	6	100	0	0

Bar graph 1: Teaching methods used during the lessons observed

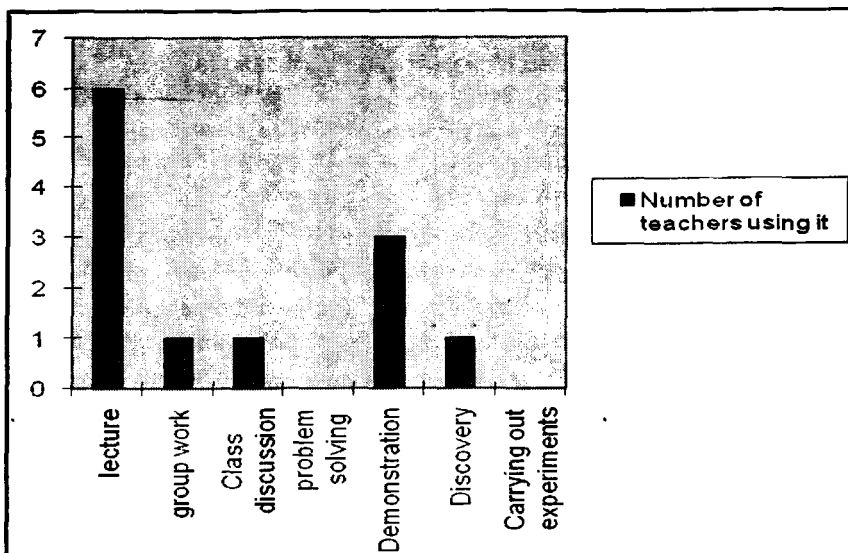


Table 3: Information on staff development programmes given to the Biology 'O' level teachers as revealed by the Science Heads of Department (H.O.Ds).

Responses of the Science Heads of Departments						
Question	Answer	Number of H.O.Ds	Answer	Number of H.O.Ds	Answer	Number of H.O.Ds
Are there any staff development programmes done as a follow up to observed lessons?	None, never done	1 (33,3%)	Yes, through team teaching and seminars	1 (33,3%)	Only at an informal level, discussing with a colleague	1 (33,3%)

Findings and discussions

All the Biology teachers were trained and had between 4 and 5 years teaching experience. Despite this experience, the research findings revealed that the teachers were not applying the constructivist

perspective in the teaching and learning of Biology at 'O' level. The teachers were aware of the constructivist perspective but demonstrated lack of knowledge about its implication in the teaching and learning of Biology at 'O' level. The teachers also exhibited lack of the necessary skills to apply the constructivist perspective in the teaching and learning of Biology at 'O' level. Furthermore the 'O' level Biology teachers were unable to state the teaching methods related to the constructivist perspective.

In the six cases, all the six teachers, indicated that they used the lecture method, a teaching method not related to the constructivist perspective more frequently than any other teaching methods in the teaching and learning of Biology at 'O' level. Only two Biology teachers used methods related to the constructivist perspective in the teaching and learning of Biology at 'O' level. The teachers who tried to use the constructivist perspective did so with great difficulty. The most available and used teaching aids by the 'O' level Biology teachers in the three schools under study were the textbook and the chalk board. The textbook was used simply to copy what is in it. Designs, procedures of experiments and content notes were simply copied from the textbook as they were.

The 'O' level Biology teachers did not give the students enough chance to discuss their findings especially when carrying out experiments. The teacher took the center stage in giving the results and the conclusions of the experiments. During the observed lessons no problem solving abilities or critical thinking were developed in the 'O' Biology students. The poor performance in Biology at 'O' level final examinations may be due to the non-application of the constructivist perspective in the teaching and learning of Biology at 'O' level in the three schools under study.

The lack of knowledge and skills on how to use the constructivist perspective on the part of the 'O' level Biology teachers and the Science Heads of Department might have been due to inadequate training. The 'O' level Biology teachers knew that the constructivist perspective exists but lack the necessary skills and knowledge to apply it during the teaching and learning of Biology at 'O' level. It seems the Biology teachers were more confident to apply the non-constructivist perspective in the teaching and learning of Biology at 'O' level such as the lecture method.

The Biology 'O' level teachers and their Science Heads of Department in the three schools needed to undergo intensive staff development programmes in order for them to develop the necessary skills, knowledge and attitudes so that the constructivist perspective is applied at a large extent in the three schools. The 'O' level Biology teachers and the Science Heads of Department had inadequate understanding of how to apply the constructivist perspective in the teaching and learning of Biology at 'O' level and this implies that there was little application of the constructive perspective in the teaching and learning of Biology in the schools under study. The lack of the necessary skills and the correct attitudes by the teachers created negative perceptions in the teachers on the use of the constructivist teaching approach.

The lecture method was still the major method of instruction used in the teaching and learning of Biology at 'O' level despite the call by the Ministry of Education, Sport, Arts and Culture for all science teachers to use the constructivist perspective in the teaching and learning of science indicating that the extent of the application of the constructivist perspective in the teaching and learning of Biology is low. The lecture method was considered by the 'O' level Biology teachers and the Science Heads of Departments as a method that make them cover a lot of ground or syllabus content in a short space of time in order to prepare the 'O' level Biology students for the final 'O' level ZIMSEC Biology examination. Education Officers and all other Education Authorities assumed that the discovery method (constructivist perspective) was being used in the schools without any effort to verify the assumption. In the three schools under study there was very little understanding of the constructivist perspective by the Biology 'O' level teachers and the Science Heads of Department therefore training was needed. Problem solving activities (constructivist perspective) were not being utilized in the teaching and learning of Biology at 'O' level in the three schools under study. The present methods of instructions being used produce students who are not able to apply Biological concepts to solve problems in daily life problems. This is evident in the poor performance shown by the students in the 'O' level ZIMSEC Biology final examination especially in questions that require problem solving. The results of this research indicated that the 'O' level Biology teachers were not applying the constructivist perspective in the teaching and learning of Biology at 'O' level in the three schools under study.

Recommendations

The study recommends that:

- Practicing Biology 'O' level teachers should undergo staff development programmes in order to equip them with the necessary knowledge and skills in terms of applying the constructivist perspective in the teaching and learning of Biology at 'O' level.
- External help from teacher training institutes especially universities should be sought in order for the Biology 'O' level teachers to be taught how to apply the constructivist perspective in the teaching and learning of Biology.
- Experimental plots, fish ponds, green houses and animal houses should be set up in all schools in order for Biology teaching to have a strong practical and real life component at 'O' level.
- Since most of the 'O' level Biology teachers also teach 'A' level biology, the researcher recommends that the same study should be undertaken at 'A' level.
- Heads of schools should also make sure that what is in the school documents such as plan books tally with what is actually happening in the school for example the teaching methods stated in the plan book should tally with the methods the teachers are using during the teaching and learning of Biology in the classroom or laboratory.

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